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TightRight : augmenting screwdrivers to reduce bone stripping rates and optimise tightness when inserting non-locking screws

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Objectives

Non-locking screws remain one of the most commonly used orthopaedic implants, however they are often poorly inserted. Exceeding the stripping torque for a screw hole reduces pullout strength. The aims of this study were firstly to quantify stripping rates and screw tightness for surgeons and secondly to assess how these change when using a screwdriver that indicates when optimum tightness is reached.

Methods

At the AO Davos Courses 2018 (Davos, Switzerland), 302 orthopaedic surgeons tightened 20 screws in two phases: Phase 1 - screws tightened to the surgeon's perception of optimum tightness. Phase 2 - using an augmented screwdriver that indicated, by audibly alarming and vibrating, when a predetermined optimum tightness was reached (defined as 70% of the maximum stripping torque). Within each phase, 10 partially inserted 3.5 mm non-locking cortical screws were tightened through a 3.5 mm plate into 4 mm thick artificial bone analogue of 0.32 g/cm³. The stopping torque for each screw was recorded and compared to the stripping torque; if the stopping torque greatly exceeded the stripping torque, tightness values >100% were possible. A confidence value in each screw's purchase was recorded, 1-10. Following tests of normality, Student t-tests were performed to compare different phases and insertion confidences.

Results

For phases 1 and 2 respectively, stripping rates were 58 ± 32% and 15 ± 25% (p<0.0001) and the tightness for all screws was 190% ± 255% (n=3020) and 87 ± 49% (n=3020) (p<0.0001). Considering only unstripped insertions, tightness was 81 ± 12% (n=1242) and 71 ± 12%

(n=2579) respectively. In phase 1, confidence was 7 ± 2 (out of 10) for screws found to have not unstripped and 6 ± 2 for stripped insertions ($p=0.441$), and 7 ± 2 and 7 ± 2 ($p=0.216$) in phase 2 respectively.

Conclusion

With an unaugmented screwdriver (Phase 1), stripping rates were high, though varied greatly amongst surgeons. Using an augmented screwdriver (Phase 2) greatly improved insertion, with optimum tightness being achieving alongside a significantly reduced rate of bone stripping. Further work incorporating these techniques into surgical education and clinical practice are recommended.